ADDING HOLDOVER CAPABILITY TO THE WRS V4

Nick Amey

OUR HISTORY

50 years experience in the frequency product market

EST. 1973

Est. 1973
Crewkerne, UK

1995 Moved to current HQ

2017 Joined WE eiSos Group

2018 Xtals/XOs into WE Catalogue

2023 50th Anniversary

IQD

IQD Frequency Products

IQD Frequency Products

I Q D
INTERNATIONAL
QUARTZ DEVICES

IQD

IQD

IQD

THE WÜRTH ELEKTRONIK GROUP

1.33 bn €
Sales

15
Quality & Design Centers

8,200
Employees

23
Production plants

50
Countries

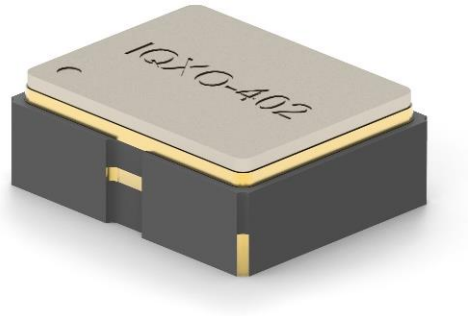
13
Warehouses

OUR PRODUCTS PORTFOLIO

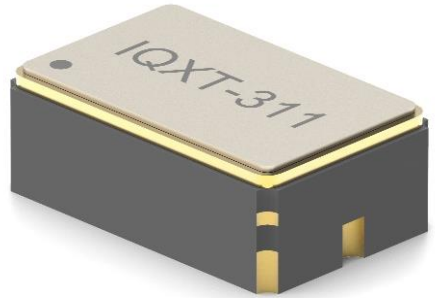
Frequency products

Watch crystal

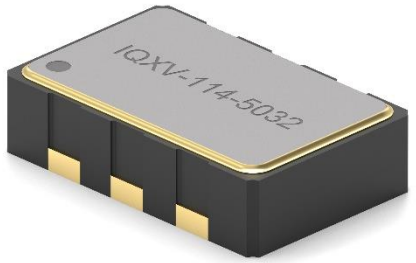
Quartz Crystal



SPXO

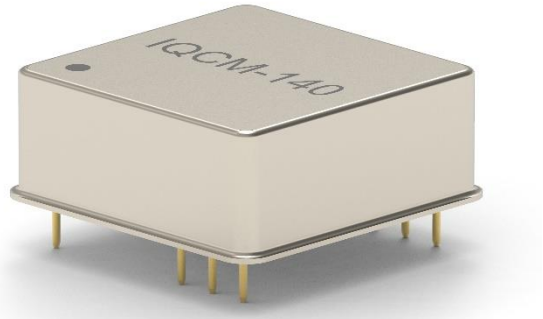


TCXO

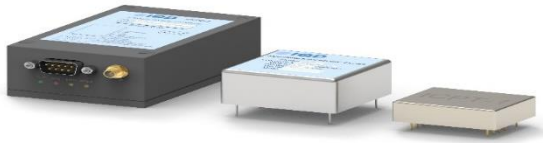


VCXO

OCXO



Disciplined OCXO



Rubidium Oscillator

WHY ARE IQD HERE TODAY?

QWRTY Project

- IQD are proud to be working with GMv and CERN
- Implementing new WRv4 Network Switch into a GMv product
- IQD are developing the Expansion Board
- The Expansion Board adds the holdover capability to the system

WHY ARE IQD HERE TODAY?

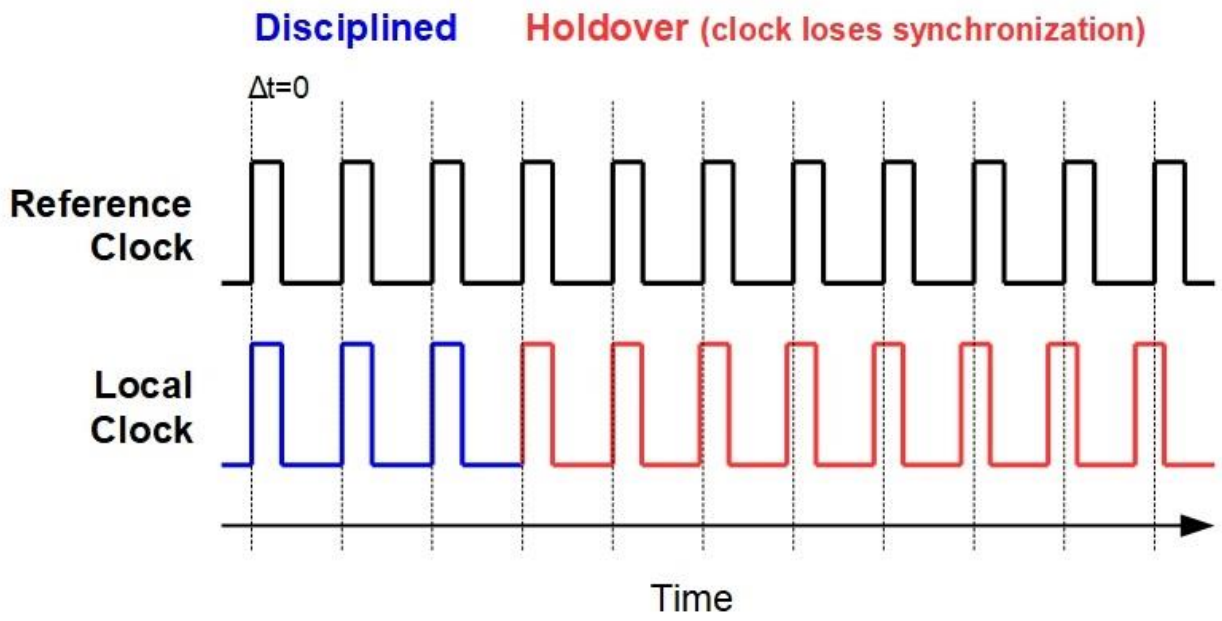
Non-open source projects

- IQD is also involved in a number of other, non-open source projects which have influence in this area:
  - Resilience in PNT
  - Development of new Rb oscillators
  - Oscillator specific ASIC design
  - Alternatives to Quartz resonators
- The WR Project has the potential to benefit from, or to, many of these projects

WHAT IS HOLDOVER?

Holdover performance is a function of the local oscillator

- All clocks need holdover
  - The gap between Synchronization Events
  - Synchronization: setting the clock
  - Holdover: time lost between synchronization events
- What happens when Synchronization is lost?
  - GNSS outage, cable damage
  - Malicious or accidental
- Holdover specifications define the behaviour, both locally and down stream
  - Requirement for ±1.5µs over 24 hours
- Recovery from holdover is also important
  - Would you want to jump 500ms in one step?
- The local oscillator dictates performance in holdover

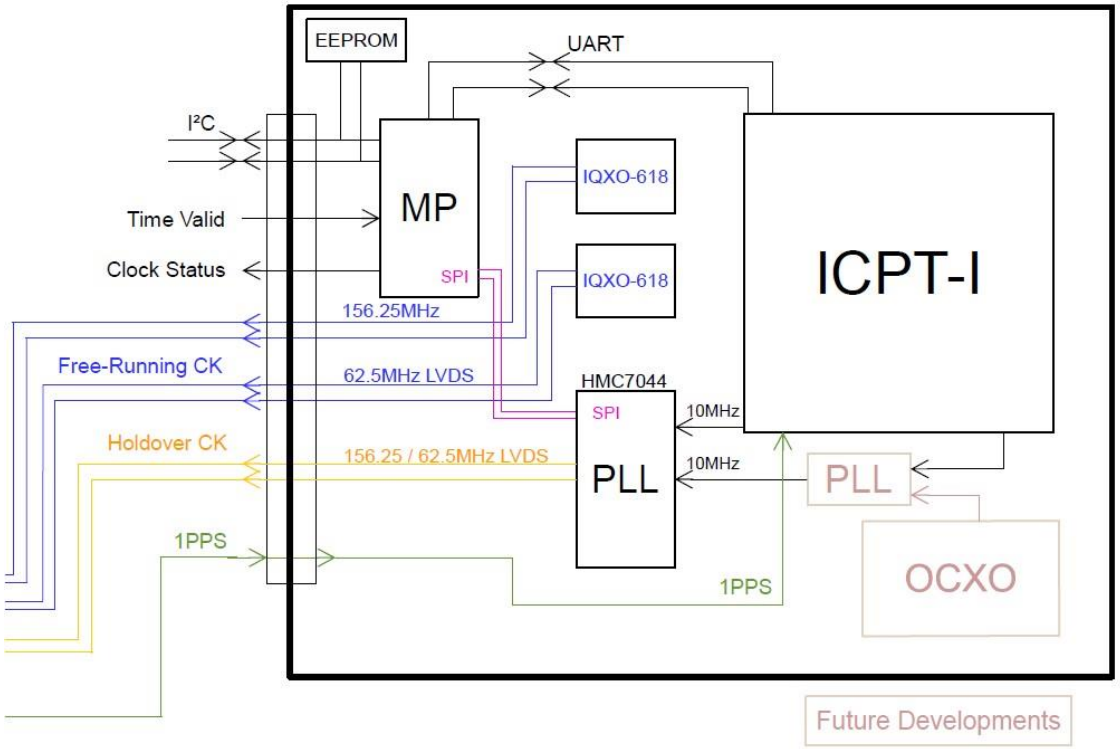


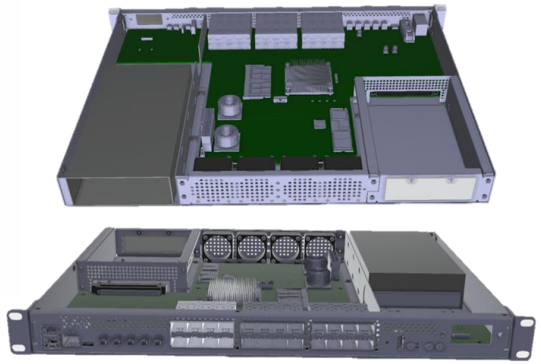
QWRTY PROJECT UPDATE

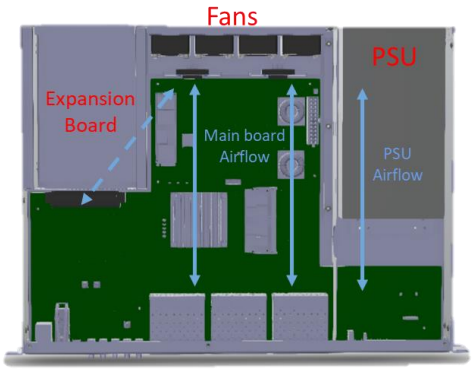
Expansion Board block diagram

- Oscillator
  - IQD's ICPT-1 Coherent Population Trap Rb oscillator
  - Disciplined to WRCK 1PPS
- Micro Processor
  - On-board device interface control
  - Communication interface between the Main Board and the Expansion Board
  - Updates the Expansion Board without having to update the Main Board
  - Firmware upgradeable
- PLL
  - Translates the10MHz signal it receives into the 156.25MHz or 62.5MHz LVDS signal needed by the Main Board
- EEPROM
  - Expansion Board ID code
- Free Running Clock
  - IQD's IQXO-618 LVDS
  - 3-way clock error checking

- Future Development for enhanced performance
  - Low PN OCXO and PLL



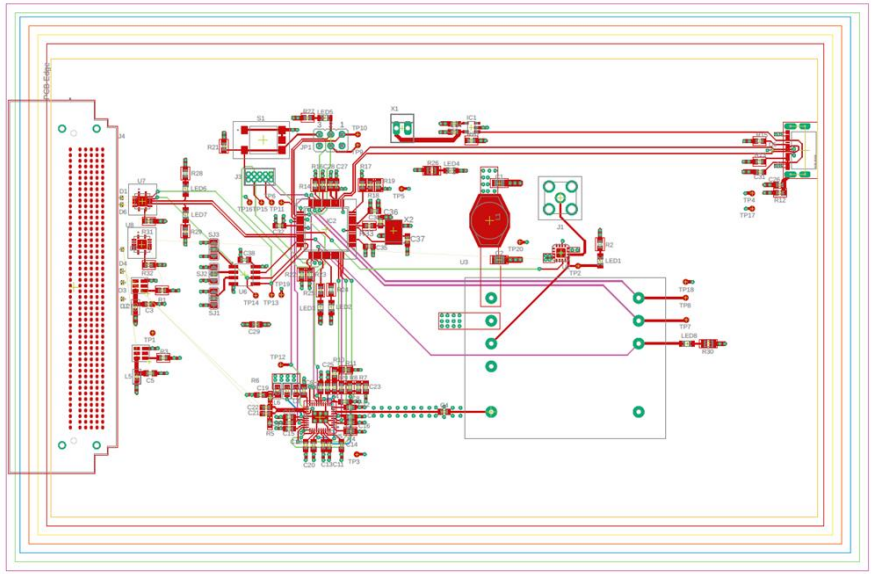


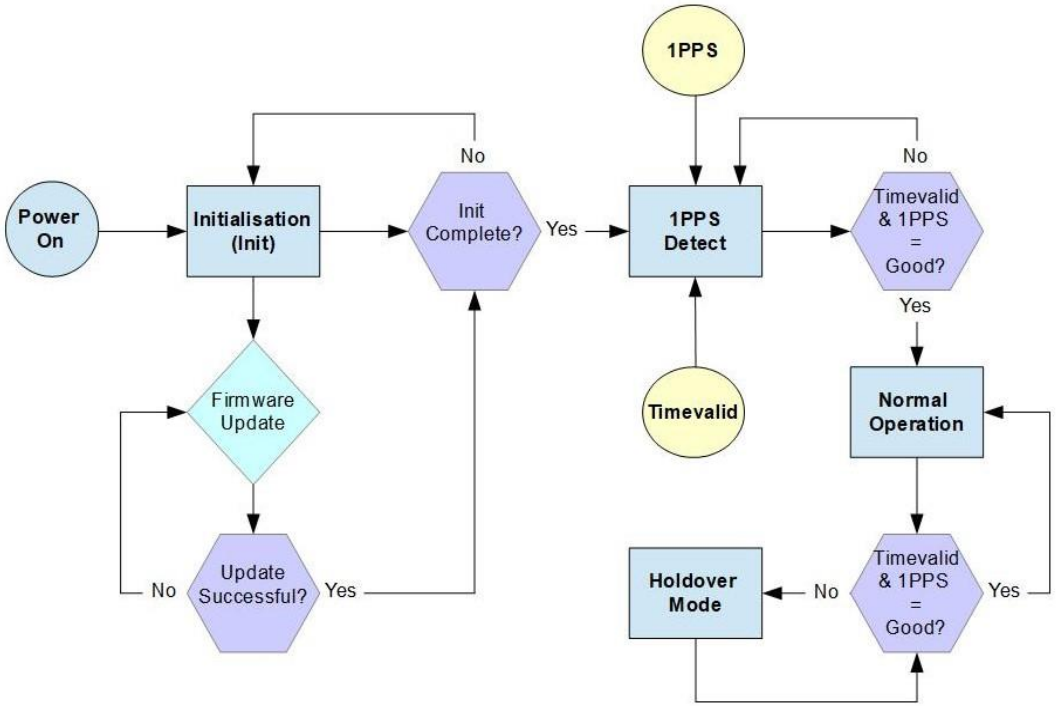


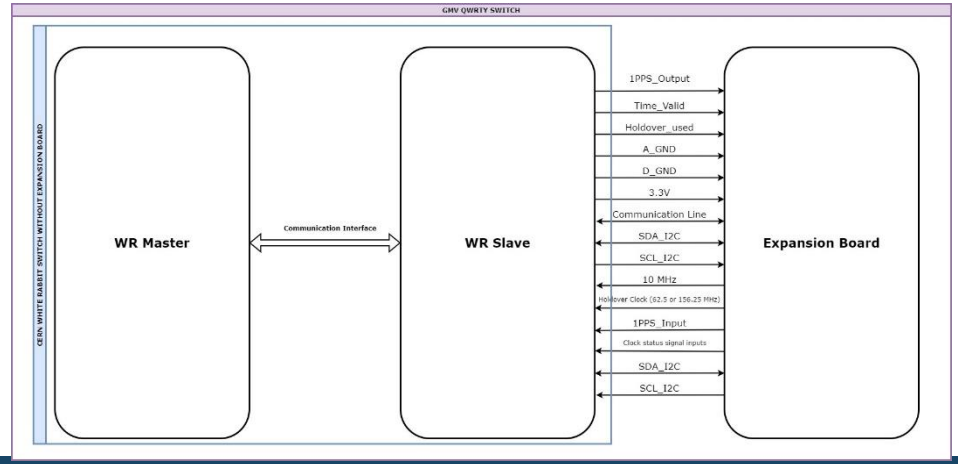
QWRTY PROJECT UPDATE

Expansion Board interface

- Software interface between the Main Board and Expansion Board
- Handshaking protocol developed
- FMC interface pin out defined
- PCB layout in progress







QWRTY PROJECT: CERN ASSISTANCE

Benefits of Collaboration Project Membership

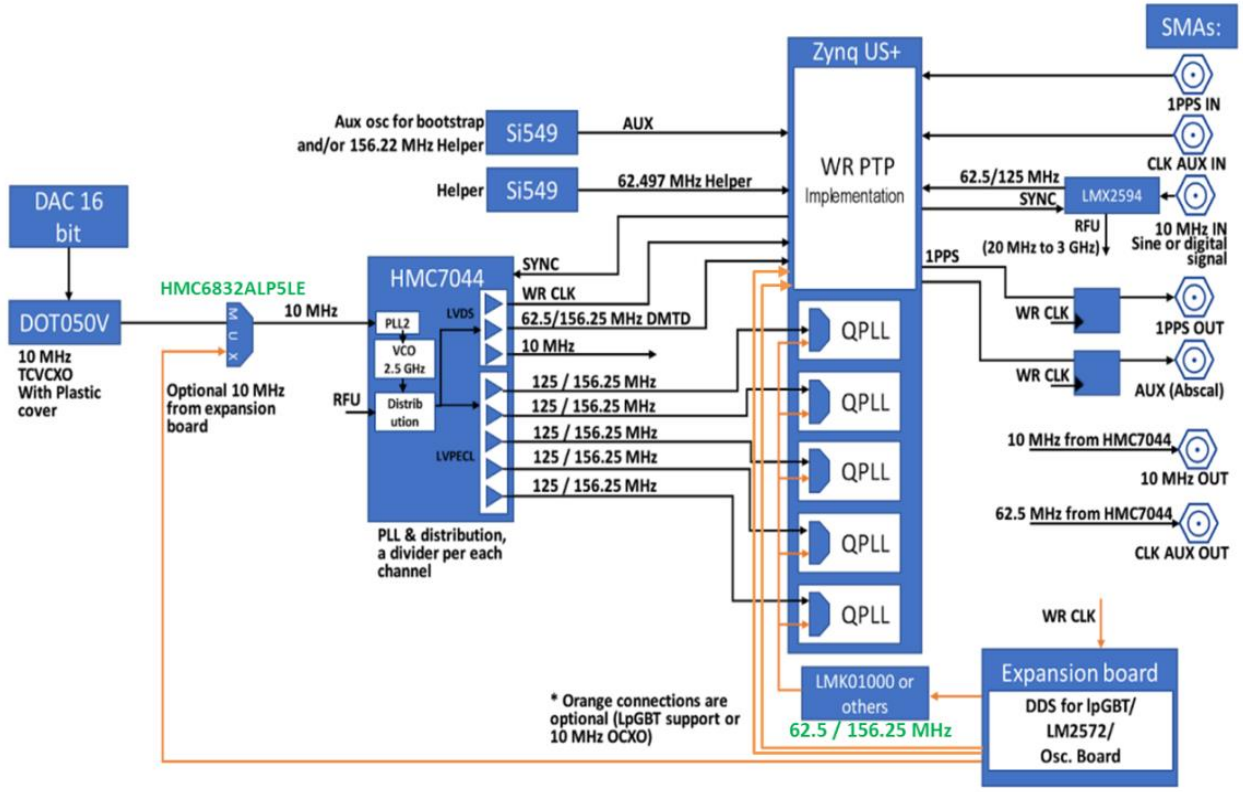
- Original idea:
  - Place holdover oscillator into the 1PPS feed
  - The Expansion Board would then provide a stable 1PPS for holdover
- Problems:
  - Signal delays
  - Limited potential for holdover detection

- After CERN input:
  - Expansion Board interfaces to the WR PTP Implementation
- Resulting solutions:
  - Signal delays handled by the WR PTP
  - Expansion Board takes the instruction from the Main Board to enter holdover
  - Possibility of a 3-way clock comparison

- Benefits of WR Collaboration Project Membership:
  - Depth of understanding of the WRv4 system
  - Integration into the WR system
  - Confidence in future compatibility

- Working directly with a partner of the WR Collaboration Project is of significant benefit to any individual project.

White Rabbit
COLLABORATION

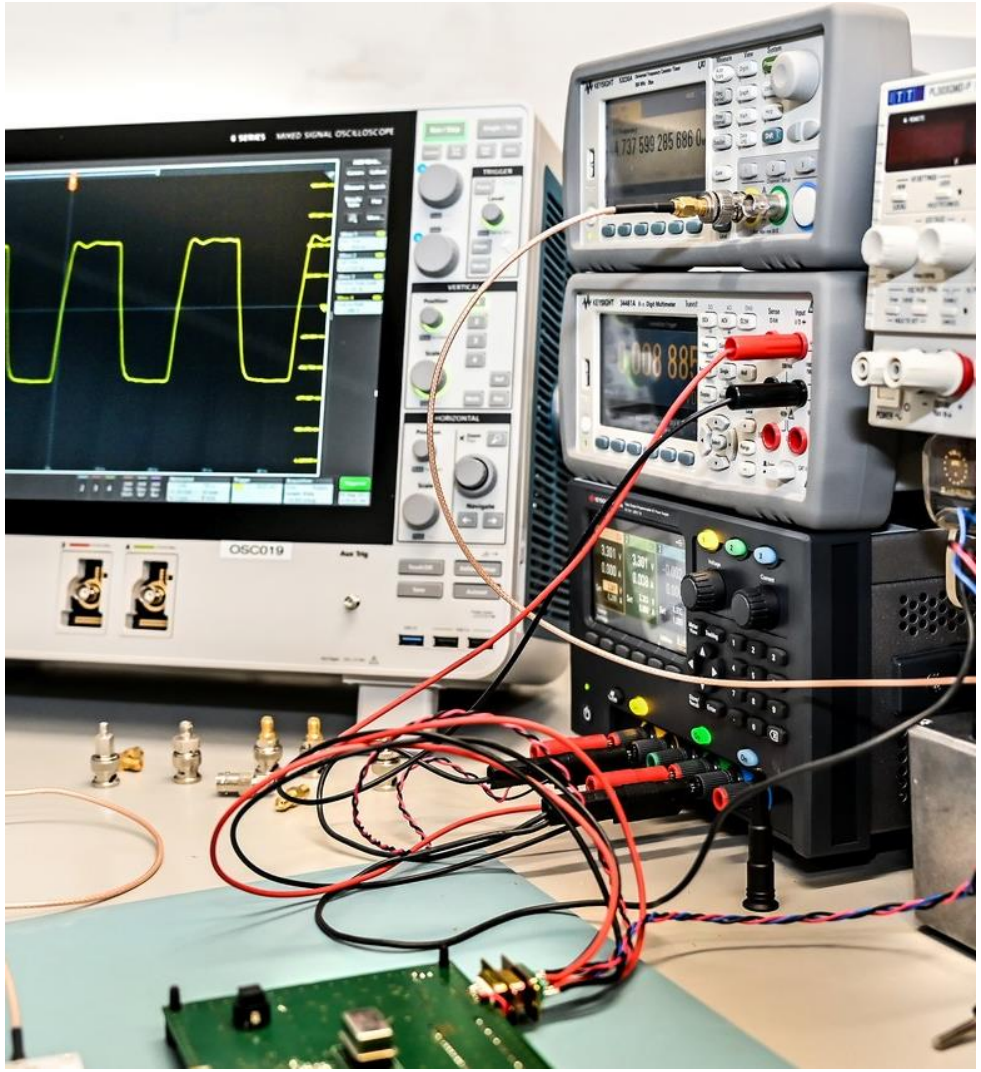


QWRTY PROJECT

Future projects for Expansion Board

- Planned projects include locking to a 2nd oscillator
  - Improved short term stability, ADEV

- Future versions
  - Long term holdover, 10 days? Power grid industry
  - Short term holdover, high performance for 1 hour? Finance Industry
  - Lower cost, TCXO based solutions
  - Multiple 1PPS outputs



IQD JOIN THE WR COLLABORATION PROJECT

We are looking forward to working with you on your projects

White Rabbit
COLLABORATION

- IQD are an oscillator company. We are here for the oscillator side of your projects
  - We can support in testing oscillators:
    - Phase Noise, ADEV, MTIE, TDEV, etc.
    - Isolating the effects of the oscillator in the system
    - Qualifying the effect of improving the oscillator in the system
  - As part of the WR Collaboration Project IQD can contribute towards:
    - Definitions of measurements for oscillators
    - Oscillator section guide for WR
    - Holdover and Oscillator training material for WR
    - Guidelines for future tests of holdover specifications.
- Any other area we can help with

IQD


IQD